DOCUMENT RESUME

ED 084 816 EM 011 635

AUTHOR	White, Mona E.; And Others
TITLE	Comprehensive Achievement Monitoring for Science. Symposium; National Association of Biology Teachers, San Francisco, California, October 27, 1972.
INSTITUTION	Sequoia Union High School District, Redwood City, Calif.
PUB DATE	27 Oct 72
NOTE	29p.; See also EM 011 636 and EM 011 637
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Achievement; *Behavioral Objectives; Biology Instruction; Chemistry Instruction; Computer Oriented Programs; *Computers; *Diagnostic Teaching; Feedback; *Individualized Instruction; Learning Activities; Performance Criteria; Performance Tests; Program Descriptions; Program Evaluation; Program Improvement; Secondary Education

ABSTRACT

Comprehensive Achievement Monitoring (CAM) is a system designed to provide a curriculum defined in terms of performance objectives, test items to measure student performance on each objective, a set of comparable test forms to evaluate performance, testing throughout the period of the course, computerized analysis and reporting of results after test administration, interpretation of results by teachers and students leading to decisions on curriculum and study priorities, and modification of curriculum, instructional activities, and CAM. This report describes the system, its strength, its computerized feedback system, and then provides the CAM design for biology at Menlo-Atherton High School (1972-1973), and the CAM designs for chemistry at San Carlos High School (1971-1972). (Author/SH)

ED 084816

COMPREHENSIVE ACHIEVEMENT MONITORING FOR SCIENCE

SYMPOSIUM
NATIONAL ASSOCIATION OF BIOLOGY TEACHERS
SAN FRANCISCO, CALIFORNIA
October 27, 1972

Mona E. White, John Easter,
Stan Ogren, George Hitz

All queries concerning the Sequoia District's comprehensive evaluation system should be sent to:

John Easter
Assistant for Research
Sequoia Union High School District

480 James Street
Redwood City, California 94063

EM 011 635

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

I. INTRODUCTION

CAM is a procedure for monitoring student achievement continuously while a program is in operation. In contrast to typical existing evaluation procedures in the schools, CAM requires the teacher to specify the objectives of a course in testable performance terms. A CAM system is predicated on four major concepts: objective sampling, item sampling, student sampling, and longitudinal testing. Several test forms are constructed using a stratified random sampling technique. Whether a given test form contains all the objectives in the course or just a sample of the objectives depends upon the evaluation design the teacher wishes to implement. For each objective on a given test form, one or more items are selected from an item pool. Test administrations occur throughout the course either at the completion of an instructional unit or after given time intervals determined by the teacher.

Although teachers develop their own evaluation designs which differ in terms of the extent of objective sampling, item sampling, and student sampling, the result is a comprehensive data base to evaluate the student and the curriculum. On a given test administration, performance on all objectives may be examined even though every student is not necessarily tested on every objective. A student receives a different test form each time he is tested. Therefore, for most of the evaluation designs now in use, data will exist for all objectives for each student when the total number of test administrations are completed.

Profiles of achievement which show group progress on any or all course objectives, test reports for individual students, and item analyses can all be generated from existing computer programs.

In summary, CAM provides a basis for immediate and long-term decision making with respect to the student, the instructional mode, and the curriculum.

COMPREHENSIVE ACHIEVEMENT MONITORING (CAM) WAS DEVELOPED UNDER THE LEADERSHIP OF DR. WILLIAM GORTH OF THE UNIVERSITY OF MASSACHUSETTS. ITS DEVELOPMENT WAS MADE POSSIBLE BY A GRANT FROM THE CHARLES F. KETTERING FOUNDATION TO DR. DWIGHT ALLEN AT STANFORD UNIVERSITY AND THE UNIVERSITY OF MASSACHUSETTS.

II. WHAT IS CAM?

A new design for evaluating classroom achievement levels has been operational in the Sequoia Union High School District since September 1970*. Called Comprehensive Achievement Monitoring (CAM), the design's methods were developed at Stanford University and the University of Massachusetts under a grant from the Charles F. Kettering Foundation.

The CAM design includes the following components:

1. A curriculum defined in terms of performance objectives.
2. Test items designed to measure student performance on each objective for the course.
3. A set of comparable test forms which evaluate performance on all or a sample of all the objectives in the curriculum.
4. Testing throughout the period of the course at intervals determined by the teacher.
5. Computerized analysis and reporting of results within a few days after each test administration.
6. Interpretation of results by teachers and students leading to decisions on curriculum, instruction, and study priorities.
7. Modification of curriculum, instructional activities, and components of the CAM design.

Each of these components is an integral part of the evaluation cycle. Evaluation becomes a continuous process which provides the teacher with constant feedback of information which he can use to improve the learning process of the students.

---

* Sequoia is pioneering the use of CAM, being the only district in California and one of three in the Western United States using CAM

Strengths of CAM

Pre-instruction measures. In a CAM design objectives can be pretested prior to instruction. If the students have acquired information and skills related to some objectives from outside sources the teacher will discover this from the pretest data and will not have to cover the material in the course. Continuous testing of objectives to be taught later in the course may indicate their relationship to objectives currently being taught. Changes in performance of specific objectives may indicate that the teacher should make alterations in the course; the sequence of instruction could be changed, the amount of time spent on certain objectives could be changed, and/or some objectives could be eliminated from the course.

Immediate post-instruction measures. The usual classroom test uses only one test item for each objective to evaluate material which has just been taught. To estimate achievement levels on just-taught objectives CAM may use more than one item for each objective. In addition, since sampling techniques are used, each objective can be tested without increasing the length of the test. Thus, with item sampling, objective sampling, and student sampling, a CAM test produces more information than the usual classroom test.

Retention measures. Particularly important for the teacher is the ability to make decisions concerning that part of the curriculum that has already been taught. Because of this, there is a continual testing for retention of material which was previously learned. Intervals between "teach" and "test" times are recorded so that analysis of retention can be made for known intervals of time. The teacher decides how many days elapse before the data represent retention. Retention

data can be used to alter the instructional process in a meaningfull manner.

The teacher makes decisions. A fundamental principle in our district's use of CAM techniques to evaluate the effectiveness of instruction is that decisions are made by the teacher. The items which are used to measure the achievement of these objectives are also determined by the teacher. Items may be either of the paper and pencil type or those that require observations by a reliable rater. Examples of types of items which may be used are:

1. True-false
2. Multiple choice
3. Completion
4. Computation
5. Essay
6. Problem solving
7. Psychomotor observations

Other decisions which teachers make in our CAM program include when and how often test monitors will be given.

Information feedback. Although the design of the testing procedures in the CAM system can become as complex as a teacher desires, the computerized information supplied to school personnel and students is easily read and understood.

For individual students it includes --

a. The total score on the current test and on each previous test.

b. The score on only those items for which instruction has occurred on the current test and on each previous test.

c. The student's response to each item on the current test reported by objectives rated as correct (+), incorrect (-), or no response (0).

d. Whether or not the student had been instructed on the item.

For any group of students in the course it includes --

1. After each test administration:

   a. The total percentage correct for each student for each test administration.

   b. The percentage correct on instructed objectives for each student for each test administration.

   c. The percentage correct for all students on each objective and any specified group of objectives, e.g., unit, for each test administration.

2. Upon demand, e.g., end of quarter or semester:

   a. An item analysis for each item as it measures achievement before instruction, immediately following instruction, and on a retention basis.

Courses in CAM. During the first semester of the 1972-73 school year seventy courses are being monitored by CAM. Many content areas are represented with courses in mathematics, biology, chemistry, physics, earth science, geography, economics, government, social psychology, anthropology, social studies, history, safety education, child development, reading, vocabulary, english, music, art, physical education, metal work, drafting, foods, Spanish, French, business law, marketing, accounting, and typing. Seventy-five teachers and approximately 6,500 students are participating in the program.

III. CAM COMPUTERIZED FEEDBACK

There are five basic types of computerized feedback: individual student reports, group summary reports, teacher summary reports, form analyses, and curriculum analyses.

Figure 1 is an example of an individual student report. Each student receives a copy of his own student report after each test administration. The data shown in Figure 1 is for Tim Boetticher's second test administration. The left portion of the report tells the student for each item on the test what objective the item was associated with, whether each item on the test was right (+) or wrong (-), and if instruction was completed on that objective (YES). The right portion of the student report summarizes the student's performance on the present test administration and all previous test administrations. He is given two scores, the percentage correct on the total test and the percentage correct on those objectives with instruction completed.

A teacher summary report is shown in Figure 2. This report provides the teacher with each student's performance on each test administration, the test form the student was administered on each test administration, the cumulative average for each student on all test items thus far (TOT) and the cumulative average for all items for which instruction was completed prior to the test administration (YES).

The Group Summary Report is used to present percentage correct for any specified set of objectives, e.g., unit or all objectives,

for any specified group of students. Each teacher usually gets one group summary for all students in the course, one for all his students, and one for each class of his students. The Group Summary Report shown in Figure 3 is for Mr. Castoro's class that meets during Period 7.

The Group Summary Report also shows the performance of the students on each objective. From this report Mr. Castoro will realize that he needs to do some extra work with the students on Objective 107 since the student performance (15%) was fairly low relative to the other objectives.

An example of a form analysis is shown in Figure 4. After each test administration, the teacher receives a form analysis for each form used during that test administration. The response data from all students in the course who received that form are included in the analysis. The print-out shows the objective number, the correct response alternative, the average percentage correct, and the percentage of students who chose each response for each item on the test form.

BOETTICHER TIM W 330183 PERIOD 7 CASTORO 09/27/72
MA210

TEST ADM 2 - 9/25/72
PERCENTAGE CORRECT ON ALL ITEMS IS 70 FORM 20
PERCENTAGE CORRECT ON YES ITEMS IS 82

QN	OBJ	RP	INS	QN	OBJ	RP	INS
1	101	$-	YES	26	201	$+	YES
2	101	$+	YES	27	201	$+	YES
3	102	$-	YES	28	201	$+	YES
4	102	$+	YES	29	202	$+	YES
5	103	$+	YES	30	203	$+	YES
6	103	$+	YES	31	203	$+	YES
7	104	$+	YES	32	204	$+	YES
8	104	$+	YES	33	204	$+	YES
9	105	$+	YES	34	204	$+	YES
10	105	$+	YES	35	205	$+	YES
11	106	$+	YES	36	206	$+	YES
12	106	$+	YES	37	206	$+	YES
13	107	$-	YES	38	206	$+	YES
14	107	$-	YES	39	206	$-	YES
15	108	$+	YES	40	206	$+	YES
16	108	$+	YES	41	301	$-	
17	108	$+	YES	42	301	$+	
18	110	$+	YES	43	302	$-	
19	110	$+	YES	44	402	$-	
20	110	$+	YES	45	403	$+	
21	111	$+	YES	46	501	$-	
22	111	$+	YES	47	502	$-	
23	112	$+	YES	48	504	$-	
24	112	$+	YES	49	507	$-	
25	201	$-	YES	50	509	$-	

TEST ADM	FORM	PCT COR TOTAL	PCT COR YES
1	2	34	0
2	20	70	82
CUM AVG		52	82

Figure 1. A copy of an individual student report.

COMPREHENSIVE ACHIEVEMENT MONITORING - TEACHER SUMMARY REPORT MA210

M-A MEDICAL CAREERS PERIOD 7 TNB 16 CASTORO

09/27/72

NUMBER	NAME		CUM AVG	TEST ADMINISTRATION 1	2	3	4	5	6	7	8	9	10
329581	BATTON BONITA L	TOT	56	36	76								
		YES	82	0	82								
		FORM		1	20								
329805	BENTLEY SUSAN M	TOT	44	24	64								
		YES	72	0	72								
		FORM		2	20								
330183	BOETTICHER TIM W	TOT	52	34	70								
		YES	82	0	82								
		FORM		2	20								
333310	DICARLO BARBARA	TOT	51	28	74								
		YES	80	0	80								
		FORM		3	20								
333443	DORSEY DOLORES	TOT	40	28	52								
		YES	62	0	62								
		FORM		2	20								
335604	GRUYTER FRANCES C	TOT	50	30	70								
		YES	77	0	77								
		FORM		2	20								
337477	JOHNSON CINDY M	TOT	56	32	80								
		YES	90	0	90								
		FORM		1	20								
338566	LEE LAIOPING	TOT	50	32	68								
		YES	70	0	70								
		FORM		1	20								
340323	MONTGOMERY KATHY A	TOT	67	46	88								
		YES	97	0	97								
		FORM		3	20								
666727	MORRIS DENISE	TOT	51	40	62								
		YES	72	0	72								
		FORM		3	20								
342014	PORATH DARLENE E	TOT	58	46	70								
		YES	77	0	77								
		FORM		3	20								
344440	SNYDER SANDRA	TOT	56	38	74								
		YES	80	0	80								
		FORM		1	20								
345546	TIRTOPRODJO LESTARI	TOT	41	20	62								
		YES	67	0	67								
		FORM		3	20								

Figure 2. A copy of a Teacher Summary Report

COMPREHENSIVE ACHIEVEMENT MONITORING - GROUP SUMMARY REPORT MA210
M-A MEDICAL CAREERS 09/27/72
STUDENT GROUP 1607 CASTORO PERIOD 7

CGN	CONTENT GROUP		TEST ADMINISTRATION 1	2	3	4	5	6	7	8	9	10
	NUMBER OF STUDENTS		13	13								
0	ALL OBJECTIVES	AVG	33	70								
		NUM	650	650								
1	UNIT 1	AVG	53	81								
		NUM	47	312								
2	UNIT 2	AVG	36	73								
		NUM	44	208								
3	UNIT 3	AVG	30	43								
		NUM	26	39								
4	UNIT 4	AVG	23	34								
		NUM	17	26								
5	UNIT 5	AVG	25	36								
		NUM	74	65								
101	OBJECTIVE 101	AVG	$$$	76								
		NUM	4	26								
102	OBJECTIVE 102	AVG	$$$	73								
		NUM	4	26								
103	OBJECTIVE 103	AVG	$$$	88								
		NUM	5	26								
104	OBJECTIVE 104	AVG	$$$	96								
		NUM	4	26								
105	OBJECTIVE 105	AVG	$$$	80								
		NUM	5	26								
106	OBJECTIVE 106	AVG	$$$	88								
		NUM	5	26								
107	OBJECTIVE 107	AVG	$$$	15								
		NUM	4	26								
108	OBJECTIVE 108	AVG	$$$	89								
		NUM	4	39								
110	OBJECTIVE 110	AVG	$$$	94								
		NUM	5	39								
111	OBJECTIVE 111	AVG	$$$	100								
		NUM	4	26								

Figure 3. A copy of a Group Summary Report.

COMPREHENSIVE ACHIEVEMENT MONITORING - FORM ANALYSIS REPORT

M-A MEDICAL CAREERS MA210 09/27/72

FORM 20 13 STUDENTS RESPONDED TO THE FORM DURING TEST ADMINISTRATION 2

QUESTION NUMBER	OBJECTIVE	ANSWER	AVG SCORE	RESPONSES (%) NR	1	2	3	4	5
1	101	2	69	0	30	69	0	0	0
2	101	5	84	7	0	0	0	7	84
3	102	3	61	0	30	7	61	0	0
4	102	2	84	0	15	84	0	0	0
5	103	1	84	0	84	0	0	15	0
6	103	2	92	0	7	92	0	0	0
7	104	3	92	0	0	0	92	7	0
8	104	1	100	0	100	0	0	0	0
9	105	2	76	0	0	76	23	0	0
10	105	1	84	0	84	15	0	0	0
11	106	2	84	0	15	84	0	0	0
12	106	3	92	0	7	0	92	0	0
13	107	1	23	0	23	53	7	15	0
14	107	2	7	0	53	7	7	30	0
15	108	3	92	0	0	0	92	7	0
16	108	4	92	0	7	0	0	92	0
17	108	2	84	0	7	84	7	0	0
18	110	2	92	0	7	92	0	0	0
19	110	3	92	7	0	0	92	0	0
20	110	1	100	0	100	0	0	0	0
21	111	2	100	0	0	100	0	0	0
22	111	3	100	0	0	0	100	0	0
23	112	4	84	0	15	0	0	84	0
24	112	2	69	0	0	69	23	0	7
25	201	4	23	0	23	53	0	23	0
26	201	4	92	7	0	0	0	92	0
27	201	4	69	7	15	7	0	69	0
28	201	1	92	0	92	0	7	0	0
29	202	2	61	7	0	61	23	7	0
30	203	4	100	0	0	0	0	100	0
31	203	4	23	0	53	7	15	23	0
32	204	2	61	7	23	61	0	7	0
33	204	1	100	0	100	0	0	0	0
34	204	1	84	0	84	0	0	15	0
35	205	3	76	7	7	0	76	7	0
36	206	2	84	7	0	84	0	7	0
37	206	2	92	7	0	92	0	0	0
38	206	4	61	0	0	38	0	61	0
39	206	3	61	7	23	7	61	0	0
40	206	2	84	0	15	84	0	0	0
41	301	2	7	0	0	7	61	30	0
42	301	4	69	7	15	0	7	69	0
43	302	3	53	23	7	0	53	15	0
44	402	3	53	7	0	30	53	7	0
45	403	3	15	7	46	30	15	0	0
46	501	1	38	0	38	7	30	23	0
47	502	3	15	7	15	15	15	15	30
48	504	5	38	7	15	7	30	0	38
49	507	2	38	7	30	38	7	15	0
50	509	2	53	7	0	53	7	15	15

PCT COR = 70

Figure 4. A copy of a form analysis report.

CAM DESIGN FOR BIOLOGY

The CAM design for biology at Menlo-Atherton High School was developed by Mr. Stan Ogren. There are four teachers and eleven biology classes involved in the program.

There are seventeen units in the first semester of the biology course. These units are:

11. Techniques used in constructing tables and graphs.
12. Learning to use significant figures.
13. Measurement utilizing the metric unit of length.
14. Measurement utilizing the metric unit of mass.
15. Measurement unilizing the metric unit of capacity.
16. Calculation of Percent.
20. Survey of Life.
21. Science as inquiry.
22. Variety of Living Things.
23. Evolution - Supporting Evidence.
24. Evolution - Theories Past and Present.
25. Chemistry and the forerunners of life.
26. Chemical energy for life.
27. Master molecules.
28. Biological code.
29. Light as energy for life.
30. Evolved cell and cell theory.

The units reflect the curriculum in the blue version BSCS test titled "Molecules to Man". There are ninety-six performance objectives for semester one. During the first week of the semester the students receive a copy of all of the objectives for semester one. In addition, the orientation article "What is CAM" is provided.

A variety of learning strategies are utilized in the course. Included are laboratory exercises, laboratory investigations, film strips, films, and readings. Some time is spent in lecture and in small group discussions. Although the student spends most of his or her time working individually or in small groups, a sequence has been established and all students cover the material at the same time.

Approximately every three weeks the students take a monitor. Within two days, they receive their student report. This provides each student with information as to his or her mastery of some or all of the objectives of the course, including objectives taught. The student and the teacher then make a decision as to what strategies are necessary in order for the student to master the objectives missed that have had instruction.

Throughout the course, four unit tests are given. These unit tests cover approximately four weeks of instructional material. They are similar to monitors in that they relate specifically to the specified performance objectives. Within a day of the unit test, each student receives a report which shows which objectives the student missed and which ones were correct.

SELECTED BIOLOGY COURSE OBJECTIVES

1104 The student will correctly interpret information from a graph.

1402 After weighing an object using the proper technique, the student will read the weight of the sample with a precision of 0.02 g.

2101 Given an example, the student will identify the example as an observation, fact, hypothesis, or assumption.

2203 The student will list the kingdom, phylim, class, for each of the following organisms: Horseshoe crab, grasshopper, dog, grass frog, and man.

2304 The student will correctly associate Darwin's postulates with his conclusions.

2503 The student will distinguish from the following list of properties - those which are chemical; those which are physical; those corresponding with oxygen; those corresponding with hydrogen:

a. colorless
b. supports burning
c. gas at room temperature
d. tasteless
e. burns
f. lighter than air

2506 Given a chemical formula such as $2H_2O$, CH_4, $3C_6H_{12}O_6$ or CO_2, the student will identify

a. the number of molecules
b. the name of the elements
c. the number of atoms of each element

Biology CAM
Menlo-Atherton High School

Mr. Ogren
1972-73

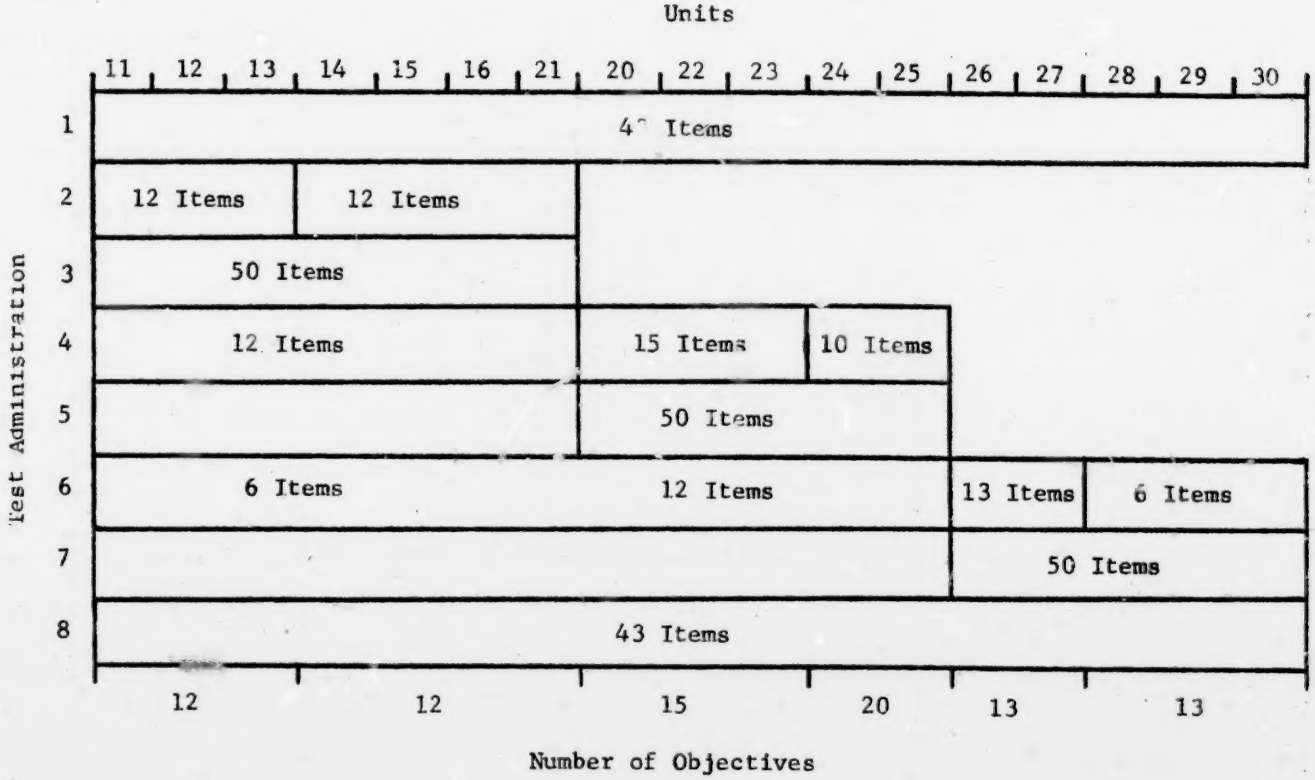
SCHEDULE - FIRST SEMESTER

Unit	Topic Description	Major Reference	Objectives	Time in Day	Wk. No.	Date	Test Admin. Period
	Orientation	Booklet #1		3	2	9/4 - 8	1
11	Tables & Graphs	Ex. 1	1103-1104	3	3	9/11 - 15	
12	Sign. Figures	Ex. 2	1205-1207	1			
13	Length	Ex. 3	1301-1307	2			
14	Mass	Ex. 4	1402	2	4	9/13-22	2
15	Capacity	Ex. 5	1501-1502	1			
16	Per Cent	Ex. 6	1601-1604	1			
21	Science & Method	Ch. 1	2101 2103-2105	3	5	9/25 - 29	
-	Celery	Inv. 1		2			
-	Potato	Inv. 3		3	6	10/2 - 6	
20	Survey of Life		2001-2003	5			
22	Taxonomy	Ch. 2	2201 2203-2206	2	7	10/9 - 10/13	3*
23	Evolution	Ch. 2,3	2301-2308	10	8, 9	10/16 - 27	
24	Origin of Life	Ch. 4	2401-2405	5	10	10/30 - 11/3	4
25	Assumption 1-4 & Chem.	Ch. 5	2501-2514 2516	15	11,12,13	11/6 - 22	
26	Energy & Catalysts	Ch. 6	2601-2607	5	14	11/27 - 12/1	5
27	DNA	Ch. 7	2701-2704 2706-2707	10	15,16	12/4 - 15	6
28	Coding	Ch. 8	2801-2805	5	19	1/2 - 5	
29	Light, P.S. & Resp.	Ch. 9	2901-2905 2904 omit	5	20	1/8 - 12	
30	Cell	Ch. 10,11	3001-3004	5	21	1/15-19	
	Review/Finals			5	22	1/22 - 26	7*
	* Unit Test						8

*Unit Monitor

MA201 Biology

Evaluation Design
Semester 1 1972-73



Standard CAM	TA 1 & 8	Forms 1, 2	43 items
Sliding CAM	TA 2	Forms 131, 132	24 items
	TA 4	231, 232	37 items
	TA 6	271, 272	37 items
Unit CAM	TA 3	Forms 211, 212	50 items
	TA 5	251, 252	50 items
	TA 7	301, 302	50 items

COMPREHENSIVE ACHIEVEMENT MONITORING - TEACHER SUMMARY REPORT

HIGH SCHOOL BIOLOGY

SECTION 5 TEACHER 1 MR. PINSKY

NUMBER	NAME		CUM AVG	TEST ADMINISTRATION 1	2	3	4	5	6	7
57998	BEARDSLEY, PAUL	TOTAL	53/136	6/34	10/34	17/34	20/34			
		INS COMPL	22/38	0/0	4/8	8/14	10/16			
87008	BOONE STEVEN	TOTAL	30/136	7/34	6/34	9/34	8/34			
		INS COMPL	12/38	0/0	5/8	4/14	3/16			
139367	CASSLEY DEBBIE L.	TOTAL	49/102	0/0	15/34	14/34	20/34			
		INS COMPL	21/38	0/0	6/8	5/14	10/16			
144158	CHAPIN TODD W	TOTAL	117/136	26/34	28/34	33/34	30/34			
		INS COMPL	37/38	0/0	8/8	14/14	15/16			
192108	DANHOF SUSAN	TOTAL	46/102	12/34	12/34	0/0	22/34			
		INS COMPL	17/24	0/0	7/8	0/0	10/16			

COMPREHENSIVE ACHIEVEMENT MONITORING - GROUP SUMMARY REPORT
PERCENTAGE OF CORRECT RESPONSES

HIGH SCHOOL BIOLOGY

STUDENT GROUP 2 MR. JOLLY'S STUDENTS

		TEST ADMINISTRATION													
CGN	CONTENT GROUP	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	ALL OBJECTIVES	28	32	39	42	50	53	58							
101	OBJECTIVE 101	80	82	84	86	82	84	83							
104	OBJECTIVE 104	60	80	90	96	92	94	91							
203	OBJECTIVE 203	40	42	80	82	73	68	55							
204	OBJECTIVE 204	30	32	48	47	51	53	52							
301	OBJECTIVE 301	30	56	57	61	60	85	87							
304	OBJECTIVE 304	76	74	76	82	84	82	83							
402	OBJECTIVE 402	85	90	92	94	92	93	94							
404	OBJECTIVE 404	18	24	22	28	40	44	52							

STUDENT REPORT

GRUYTER FRANCES C 335604 SECTN 3 MR OGREN

TEST ADM 6 - 11/15/71 FORM 53

FRACTION CORRECT ON ALL ITEMS IS 24/34
FRACTION CORRECT ON YES ITEMS IS 17/20

OBJ A INS	OBJ A INS	TEST ADM	FRN COR TOTAL	FRN COR YES
1104 + YES	2601 -	1	9/34	0/0
1302 + YES	2602 -	2	12/34	3/4
1402 + YES	2701 +	3	18/34	6/8
1601 + YES	2703 +	4	17/34	7/12
2101 - YES	2704 +	5	20/34	14/16
2104 - YES	2704 +	6	24/34	17/20
2204 + YES	2802 -			
2206 + YES	2805 -			
2301 + YES	2902 +			
2304 + YES	2905 +			
2307 + YES	3001 -			
2308 + YES	3002 -			
2402 + YES	3003 +			
2403 - YES	3004 -			
2501 + YES	0			
2502 + YES	0			
2507 + YES	0			
2508 + YES	0			
2511 + YES	0			
2513 + YES	0	CUM AVG	100/204	47/60

V. Monitoring Student Performance in Chemistry

During the first year (1971-72) of Comprehensive Achievement Monitoring of chemistry at San Carlos, two kinds of standard CAMs were used. The first was a standard CAM on the course content for the entire year. This CAM was administered at the very beginning of the year (for entry level information), at the end of the first semester (as a semester exam) and at the end of the year (as a final exam). The second kind of standard CAM was based on the content for one quarter of the course. These tests were administered at the end of the third, sixth, and ninth week of each quarter marking period. This evaluation design is shown in Figure 1. In Figure 1, the units (essentially chapters in the text) are indicated by the objective numbers illustrated at the top of the columns under the numbers which represent the quarters for the school year.

Questions on both the year CAM and the quarter CAMs can be broken down into three categories. The first category is preview questions, i.e., questions for which students had received no classroom instruction. Preview questions provide entry level information and allow students to sample questions on units which lie ahead. The second category is post-instruction questions which provide information on how well the student has mastered the unit most recently completed. Finally, there are long term retention questions which are questions on objectives where instruction has been completed but some time has elapsed (usually more than 30 days) since instruction was completed. The small block at the end of each test administration for the standard CAM for the quarter represents the few test items on the objectives to be taught during the following quarter.

Each of the tests administered was divided into two parts. The first section contained questions which the student had to answer without the use of his text book. For the second section, the student had free use of his text and his class notes. There was an open-book section for each test because the design of the chemistry program is to encourage student use of text, notes, and charts.

One of the computerized print-outs that the teacher receives at the end of each quarter or semester is an item analysis. The item analysis can, among other things, alert the teacher to items that are too easy, too hard, unclear, or not adequately related to the objective. A portion of an item analysis for the 1971-72 first semester of chemistry is shown in Figure 2. The analysis shows the percentage correct for several items that were administered to the student prior to instruction. The percentage correct on these items ranges from 6 to 20 with most of the percentages below the expected chance level of 20. Since performance level was so far below expectations, the chemistry teachers decided to deemphasize preinstruction questions during the 1972-73 academic year.

A portion of an item analysis showing performance on items related to objectives just taught is presented in Figure 3. These data which show high performance on a postinstruction basis are typical of the students' postinstructional performance on the other objectives in the course.

Given that the preinstruction information did not seem useful and that the postinstruction was useful, the chemistry teachers decided that the evaluation design for 1972-73 should emphasize postinstruction and long term retention. In addition, the teachers decided to drop the

two component aspect of the tests and allow students to use the text and their class notes throughout the test.

The evaluation design for 1972-73 is shown in Figure 4. Each block represents a sliding unit test. Note that the blocks vary in length due to the differences in length and difficulty among the various chapters. The small block in front of all but the first unit test represent items to test retention of the previous chapter. The objectives to be tested in the retention portion of one test are determined from the data output from the previous test.

For example, on the Teacher Summary Report shown in Figure 5, Objectives 9008 and 9012 can be identified as the ones most frequently missed during the first test administration. Items related to these two objectives will be included as retention items in the test given on the next unit.

The changes in evaluation design and the method used to determine the retention objectives for the 1972-73 design are examples of the usefulness and value of the CAM system.

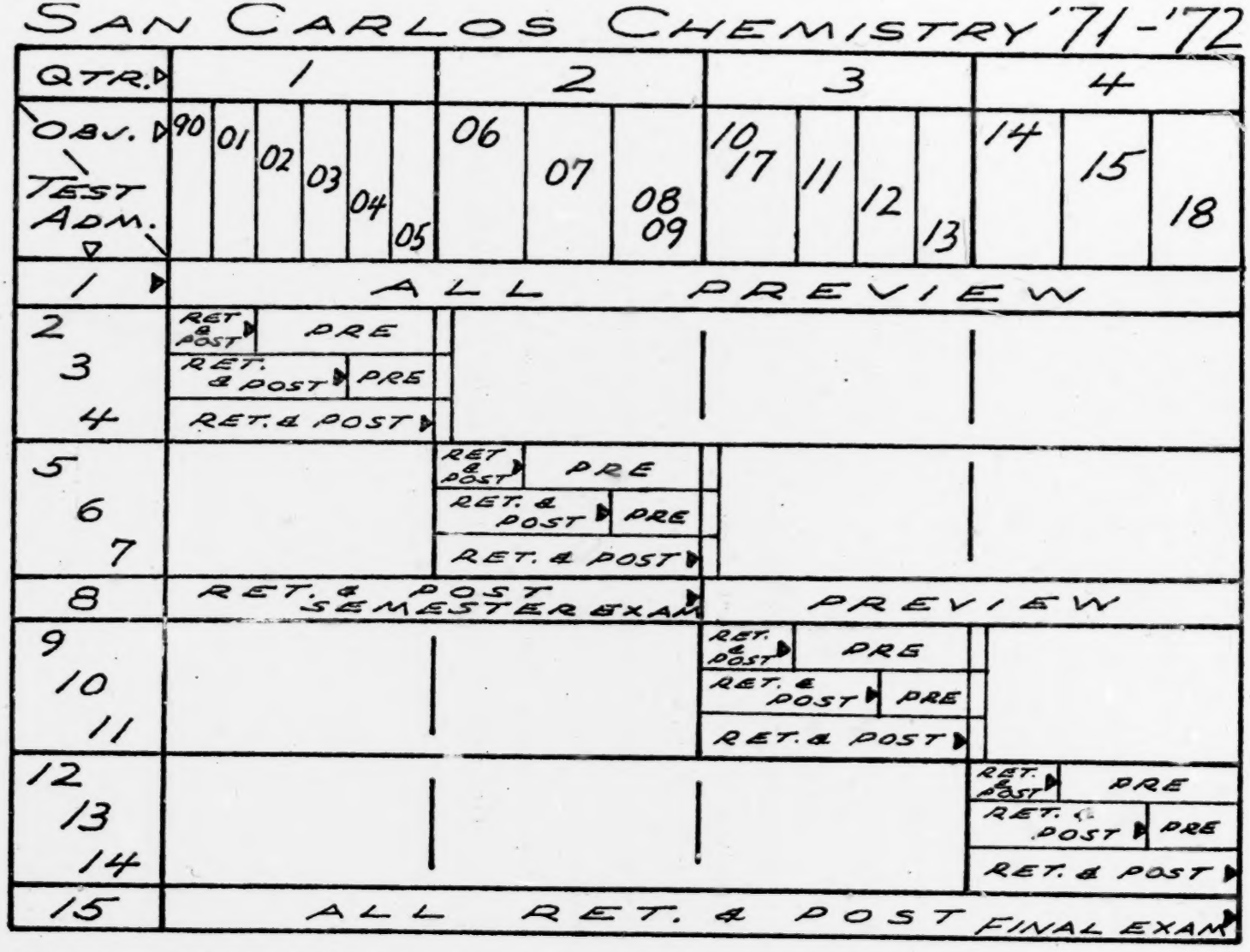


Figure 1. Evaluation design for chemistry, semester 1 and 2. 1971-72.

SAN CARLOS CHEMISTRY

UNIT 17

FROM -999 DAYS TO -1 DAYS PREINSTRUCTION

	ITEM NUMBER	COR ANS	NUM	PER COR		0	RESPONSES 1	2	3	4	5
	170002	4	74	20	←	20	2	0	17	20	39
	170003	3	79	22	←	16	3	36	22	15	5
OBJ	1700		153	21							
	170203	4	74	6	←	60	4	10	9	6	8
OBJ	1702		74	6							
	170401	1	79	7	←	60	7	7	8	7	7
OBJ	1704		79	7							
	170601	1	79	12	←	62	12	3	2	8	10
OBJ	1706		79	12							
	170906	1	79	13	←	51	13	6	8	11	7
OBJ	1709		79	13							

SUMMARY DATA FOR UNIT 17

464 (14) ← Indicates no appreciable entry level knowledge!

Figure 2 Analysis of preinstruction information, first semester, 1971-72

SAN CARLOS CHEMISTRY

UNIT 90

FROM 0 DAYS TO 25 DAYS POSTINSTRUCTION

	ITEM NUMBER	COR ANS	PER NUM	PER COR	0	1	2	3	4	5
	900106	1	37	54	0	54	0	2	(43)	0
	900107	2	38	78	0	13	78	5	2	0
OBJ	9001		75	66 ←						
	900202	1	39	76	0	76	7	12	2	0
	900203	2	0	0	0	0	0	0	0	0
OBJ	9002		39	76 ←						
	900302	3	39	92	2	5	0	92	0	0
	900304	4	39	94	0	2	2	0	94	0
	900305	2	0	0	0	0	0	0	0	0
OBJ	9003		78	93 ←						
	900402	1	37	89	0	89	0	0	8	2
OBJ	9004		37	89 ←						
	900503	2	37	70	0	2	70	24	2	0
	900504	5	39	97	0	2	0	0	0	97
OBJ	9005		76	84 ←						

Figure 3. Analysis of first semester, 1971-72.

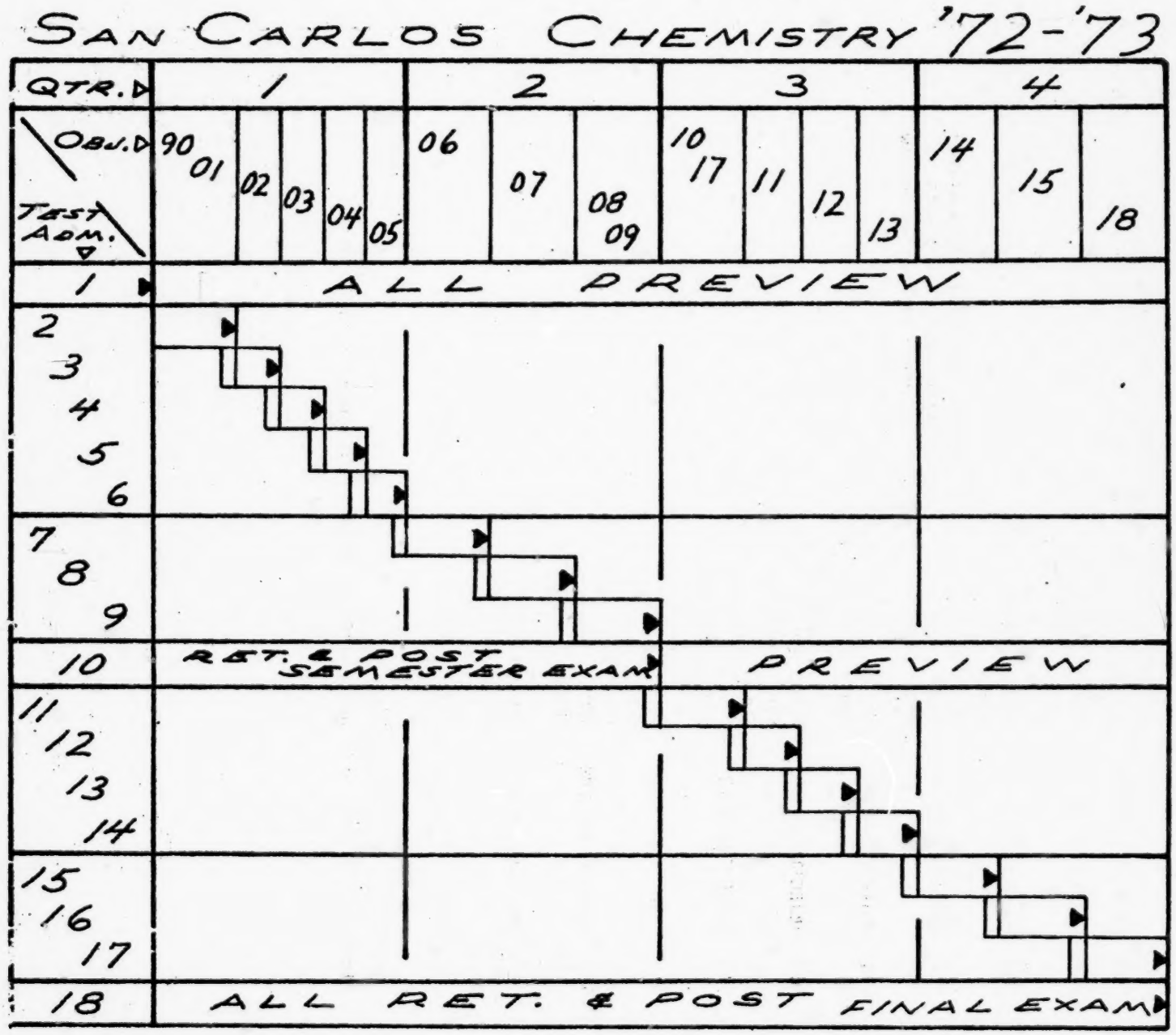


Figure 4. Evaluation design for chemistry, semester 1 and 2, 1972-73.

COMPREHENSIVE ACHIEVEMENT MONITORING - GROUP SUMMARY REPORT SC203

SAN CARLOS CHEMISTRY 10/12/72

STUDENT GROUP 1 ALL STUDENTS IN THE COURSE

CGN	CONTENT GROUP		TEST ADMINISTRATION 1	2	3	4	5	6	7	8	9	10
008	OBJECTIVE 9008	AVG	49									
		NUM	157									
009	OBJECTIVE 9009	AVG	67									
		NUM	157									
010	OBJECTIVE 9010	AVG	57									
		NUM	157									
011	OBJECTIVE 9011	AVG	70									
		NUM	157									
012	OBJECTIVE 9012	AVG	40									
		NUM	157									
013	OBJECTIVE 9013	AVG	71									
		NUM	157									
014	OBJECTIVE 9014	AVG	$$$									
		NUM	0									
991	POST OBJECTIVES	AVG	$$$									
		NUM	0									
992	PRE OBJECTIVES	AVG	71									
		NUM	3140									

Two most frequently missed objectives. They will be included on TA 2 as review questions.

Figure 5. A copy of a Group Summary Report for semester 1, 1972-73.

NELSON TERI L 391599 PERIOD 3 HITZ
SC203

TEST ADM 1 - 10/ 6/72
FRACTION CORRECT ON ALL ITEMS IS 16/ 40 FORM 13
FRACTION CORRECT ON YES ITEMS IS 0/ 0

QN	OBJ	RP	INS	QN	OBJ	RP	INS	TEST ADM	FORM	FRN COR TOTAL	FRN COR YES
14	100	$+		4	9004	$-	←	1	13	16/40	0/ 0
15	100	$-	←	5	9005	$-	←				
16	103	$-	←	6	9006	$+					
17	103	$+		7	9007	$-	←				
18	104	$+		8	9008	$-	←				
19	104	$-	←	9	9009	$-					
20	104	$+		10	9010	$+					
1	9001	$-	←	11	9011	$-	←				
2	9002	$+		12	9012	$-	←				
3	9003	$+		13	9013	$-	←				
								CUM TOT		16/ 40	0/ 0

Figure 6. A copy of an individual student report.